7

of retinal drugs delivered in an encapsulate such as a liposome or employment of other molecules which are light activated that have a therapeutic effect within the area of interest of laser illuminated tissue.

The device allows for rapid and precise placement of PDT. High performance digital image processing and tracking coupled with computer controlled delivery of laser treatment is provided. The use of treatment mapping on digital imagery allows for precise localization of treatment application to a specific area of the retina. An embodiment of the invention uses computer guidance for the precise application of laser delivery to the retina in which the position, energy level, and duration of laser treatment are controlled spot by spot rather than a non-specific uniform energy level grid pattern. The delivery of laser energy may also be performed in a continuous raster application, again with beam intensity and dwell time modified as necessary at any given place in the raster epoch.

FIG. 6 is a schematic diagram illustrating a system 600 according to an embodiment of the invention. The system 600 includes a retinal imager 610 for capturing a diagnostic image of a retina having at least one lesion, wherein the lesion includes a plurality of spots to be treated. The retinal imager 610 also captures a real-time image and updated real-time images of the retina using eye tracking and/or image stabilization. In at least one embodiment, the eye tracking determines the position and/or size of each of the spots. With the patient positioned at the diagnostic and therapeutic SLO, registration of the live (real-time) retinal image is obtained with the stored image data using image tracking and stabilization.

A user interface 620 is provided for receiving information. The information includes a duration, intensity, and/or wavelength of treatment for each of the spots. In at least one embodiment, the information includes the position and/or size of each of the spots. As described above, computer guidance is used for the precise application of laser delivery to the retina in which the position, energy level, and duration of laser treatment are controlled spot by spot rather than a non-specific uniform energy level grid pattern.

The device further includes a processor 630 for creating a composite image by linking the diagnostic image to the real-time image. As described above, with the patient positioned at the diagnostic and therapeutic SLO, registration of the live (real-time) retinal image is obtained with the stored image data using image tracking and stabilization. The processor 630 also creates an annotated image by modifying the composite image based on the updated real-time image. In at least one embodiment, the processor 630 is located in the computer 110.

A laser 640 is provided for delivering a localized laser beam to each of the spots according to the information, the composite image, and the annotated image. The delivery of laser energy may be performed in a continuous raster application, with beam intensity and dwell time modified as necessary at any given place in the raster epoch. As described above, an indicator dye locator is also provided for determining the position and/or size of the spots. In at least one embodiment, the retinal imager 610 and laser 640 are located in the instrument 100.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the root terms "include" and/or "have", when used in this specification, specify the presence

8

of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

The corresponding structures, materials, acts, and equivalents of all means plus function elements in the claims below are intended to include any structure, or material, for performing the function in combination with other claimed elements as specifically claimed. The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The embodiment was chosen and described in order to best explain the principles of the invention and the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

VII. INDUSTRIAL APPLICABILITY

The invention can be utilized in a variety of settings to provide accurate imaging, diagnosis and treatment of lesions on a retina by accurately delivering laser energy to particular parts of the retina. For example, a physician wishing to image and treat lesions on a patient's retina would benefit by being able to compare a contemporaneous image of the lesions with previously taken images of the patient's retina prior to delivering laser energy. Also the invention can be used to diagnose and identify abnormal neovascular membranes in real-time, capture the precise location of the affected retinal tissue, and utilize the same optical pathway to precisely apply therapeutic photodynamic therapy.

I claim:

1. A method including:
    capturing a diagnostic image of a retina having at least one lesion, said lesion including a plurality of spots to be treated;
    storing said diagnostic image;
    receiving information from a user interface, said information including at least one of:
    a duration of treatment for each of said spots,
    an intensity of treatment for each of said spots, and
    a wavelength of treatment for each of said spots;
    capturing a real-time image of said retina using at least one eye tracking apparatus;
    creating a composite image by linking said diagnostic image to said real-time image;
    storing said composite image;
    obtaining at least one updated real-time image of said retina using said eye tracking apparatus;
    creating an annotated image by modifying said composite image based on said updated real-time image; and
    delivering a localized laser beam to each of said spots according to said information, said composite image, and said annotated image.

2. The method according to claim 1, further comprising stabilizing said captured images of the retina by processing said images with an image stabilization system.

3. The method according to claim 1, further comprising capturing at least one image of the retina after delivery of said localized laser beam to said spots on the retina.